DVD+Recordable

Video Format Specifications

System Description

Version 3.0

July 2005

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1. General

1.1 About this document

This document specifies the DVD+R Video Format intended for home video recording on single or dual layer DVD+R media. DVD+R Video discs are designed to be playback compatible with the majority of DVD-Video players.

This is a draft document intended for review by the DVD+RW Alliance.

In Version 2.0, support for dual layer DVD+R discs has been added. Also some of the additional navigation flexibility of DVD+RW Video version 2.0 has been included.

In Version 2.1, all references to two different versions (1.2 and 2.0) of the DVD+RW Video Format Specifications are changed to references to the new version 2.1, which replaces both old versions.

In Version 3.0 changes are made to allow an open session recording using DVD+RW Video Format with VERN field of VRMI-GI set to (0020h). This is to allow for additional flexibility in the menus with more than 3 commands in the PGC Command Table for the titles.

In Version 3.0 changes are made to allow an open session recording using DVD+RW Video Format with VERN field of VRMI_GI set to (0030h). This is allowed specifically for use of the Video Content protection System.

In Version 3.0 changes are made to the RSAT structure for the case that the Video Content Protection System (VCPS) structures are used.

1.2 Scope

This document defines the data structures related to the video recording application. The mechanical, optical and physical characteristics of the recording medium, the low-level data format and the recording method are specified in the DVD+R Basic Format Specifications [1] and [7].

1.3 Application overview

The DVD+RW Video format as defined in the DVD+RW Video Format Specifications [3] was created for home video recording on DVD+RW discs, which are playback compatible with the majority of the installed base of consumer DVD-Video players. In addition to these rewritable media, DVD+R write once discs could be applied for home video recording.

The DVD+RW Video format requires that the file system and menu structures be recorded in front of the actual video recordings in the Data Zone of a disc. This is necessary for compatibility with DVD read-only players. As a consequence of the write once nature of DVD+R discs, writing the file system and menu structures at the required position blocks further recording on the same disc in a compatible way. Therefore writing the final file system and menu structures should be done in a separate step, at a moment determined by the user. After this step the first “Session” is closed. If desired, it is still possible to add non-video data in additional Sessions, which are invisible for DVD-Video players.

The DVD+R Video Format has been designed such that the application format in the closed first Session complies with [3] with only minor exceptions. This document mainly deals with the DVD+R Video data organisation in an open first Session on a single or dual layer DVD+R disc.

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1.4 References and conformance

[1] Hewlett-Packard, Mitsubishi Chemical, Philips, Ricoh, Sony, Yamaha: *DVD+R 4.7 Gbytes Basic Format Specifications (Version 1.3, July 2004)*

[2] Hewlett-Packard, Mitsubishi Chemical, Philips, Ricoh, Sony, Yamaha: *DVD+RW 4.7 Gbytes Basic Format Specifications (Version 1.2, December 2002)*

[3] Royal Philips Electronics: *DVD+RW Video Format Specifications (Version 3.0, July 2005)*

[4] DVD *Specifications for Read-Only Disc - Part 2: File System Specifications (Version 1.0, August 1996)*

[5] DVD *Specifications for Read-Only Disc - Part 3: Video Specifications (Version 1.1, December 1997, including supplemental information up to January 2001)*

[6] ISO/IEC 13818-1: *1995 Information technology – Generic coding of moving pictures and associated audio information: Part 1: Systems (MPEG-2 Systems)*

[7] Hewlett-Packard, Mitsubishi Chemical, Philips, Ricoh, Sony, Yamaha: DVD+R 8.5 Gbytes Basic Format Specifications (Version 1.0, March 2004)

[8] Philips, *Video Content Protection System for the DVD+R/+RW Recording Format, System Description (Version 1.3)*

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1.5 Definitions

1.5.1 Data Zone

On a DVD+RW disc and on a single-Session DVD+R or DVD+R-DL disc, the Data Zone is the area between Lead-in Zone and Lead-out Zone or temporary Lead-out Zone. On a DVD+R-DL disc, the Data Zone may be extended over two recording layers. On a multi-Session DVD+R or DVD+R-DL disc, each Session has a Data Zone.

1.5.2 DVD+R disc

Recordable optical medium that complies with the specifications defined in [1].

1.5.3 DVD+R-DL disc

Recordable optical medium that complies with the specifications defined in [7].

1.5.4 DVD+R Video disc

DVD+R or DVD+R-DL disc containing DVD+R Video data structures in the first Session, as specified in this document.

1.5.5 DVD+RW disc

ReWritable optical medium that complies with the specifications defined in [2].

1.5.6 DVD+RW Video disc

DVD+RW disc containing DVD+RW Video data structures as specified in [3].

1.5.7 DVD-Video format for read-only discs

Format as specified in [5].

1.5.8 DVD-Video Zone

Contiguous piece of the Data Zone on a DVD-Video, DVD+RW Video disc or closed DVD+R Video Session that contains the DVD-Video compatible data structures.

1.5.9 ECC Block

Entity defined in [1], [2] and [7]. One ECC Block is a contiguous piece of the written bit-pattern containing 16 Physical Sectors. ECC Blocks are aligned with the start of the Data Zone.

1.5.10 Incomplete Fragment

Zero or more sequentially recorded sectors at the end of an open Session. An open DVD+R Video Session contains one Incomplete Fragment, immediately following the Run-in block after one Reserved Fragment.

1.5.11 Logical Sector / Logical Sector Number (LSN)

A Logical Sector is a data allocation unit within the Data Zone of a DVD+RW, DVD+R or DVD+R-DL disc. Logical Sector Numbers are assigned in ascending order to consecutive Logical Sectors starting from 0 at the start of the Data Zone. The size of a Logical Sector shall be 2048 bytes.

1.5.12 MPEG-2 Program Stream (MPEG-2 PS)

Program Stream as defined in [6].

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1.5.13 Physical Sector / Physical Sector Number (PSN)

Entity defined in [1] and [7]. The first Physical Sector of the Data Zone shall have PSN (030000h). Physical Sector Numbers increase by 1 for each next Physical Sector in the Data Zone, except for a discontinuity at the layer boundary of dual layer discs.

1.5.14 Reserved Fragment

Group of contiguous physical sectors within the Data Zone of an open Session that shall be recorded sequentially from the sector with the lowest LSN towards the sector with the highest LSN. A Reserved Fragment is followed by a Run-in block. An open DVD+R Session contains one Reserved Fragment that shall be left completely unrecorded until the Session is closed.

1.5.15 Reserved Space Allocation Table (RSAT)

Data structure containing information about the mapping of sector locations in the Reserved Fragment to sectors in the Incomplete Fragment.

1.5.16 Run-in block

One ECC Block with unspecified contents between any two Fragments.

1.5.17 Table of Contents Blocks

Data structures defined in [1] and [2], containing information about Sessions and, if applicable, the layer jump position.

1.5.18 Video Manager (VMG)

DVD-Video data structures containing information about the recorded video data and optionally a menu.

1.5.19 Video Recording Manager (VRM)

Data structures recorded in addition to the DVD-Video data structures to support the video recording application.

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1.6 Notations

Numbers in decimal notation are represented by a sequence of one or more decimal digits (0,1,2,3,4,5,6,7,8,9).

Numbers in hexadecimal notation are represented by a sequence of one or more hexadecimal digits (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F), suffixed by “h”.

Numbers in binary notation are represented by a sequence of one or more binary digits (0,1), suffixed by “b”.

All bits of fields that are specified to be **reserved** contain the value 0b unless specified otherwise.

1 kB represents 2^{10} bytes.

1 MB represents 2^{20} bytes.

1 Mbps represents 10^6 bits per second.

When a field within a data structure has **RBP n**, this shall mean that the first byte of that field is at relative byte position n from the start of the data structure. The first byte of the data structure is at RBP 0.

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1.7 Acronyms

APS	Analog Protection System
APSTB	APS Trigger Bits
AVDP	Anchor Volume Descriptor Pointer (UDF)
CGMS	Copy Generation Management System
DVD	Digital Versatile Disc
DVD+R	Recordable disc according to the DVD+R Basic Format Specifications
DVD+R-DL	Dual Layer Recordable disc according to the DVD+R Basic Format Specifications
DVD+RW	ReWritable disc according to the DVD+RW Basic Format Specifications
FS	File System
LSN	Logical Sector Number
PS	Program Stream
PSN	Physical Sector Number
RBP	Relative Byte Position
RSAT	Reserved Space Allocation Table
UDF	Universal Disk Format
VMG	Video Manager
VMGI	Video Manager Information
VMGM	Video Manager Menu
VOB	Video Object
VOBs	Video Objects
VOBS	Video Object Set
VRM	Video Recording Manager
VRMI	Video Recording Manager Information
VRMI_GI	General Information of Video Recording Manager Information
VTS	Video Title Set
VTSI	Video Title Set Information
VTSM	Video Title Set Menu
VTSTT_VOBS	Video Object Set for Titles in a VTS

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2. Introduction to the DVD+R Video Format

2.1 Recording medium

The recording medium for the DVD+R Video format shall be a single or double-sided optical disc complying with the DVD+R 4.7 Gbytes Basic Format Specifications [1] or with the DVD+R 8.5 Gbytes Basic Format Specifications [7].

A DVD+R or DVD+R-DL disc is a DVD+R Video disc if the first Session on at least one of the sides of the disc contains a data format according to this DVD+R Video specification. This first Session is called the DVD+R Video Session. In this document the word “DVD+R Video disc” is used as a synonym for “one side of a DVD+R disc with a data format according to this DVD+R Video specification”.

A DVD+R Video disc shall be in one of the following states:

1. The DVD+R Video Session is open
   In this case the single Session on the disc shall contain one Reserved Fragment followed by one Incomplete Fragment. As the first Session is still open, no additional Sessions are present and the disc is not finalised.

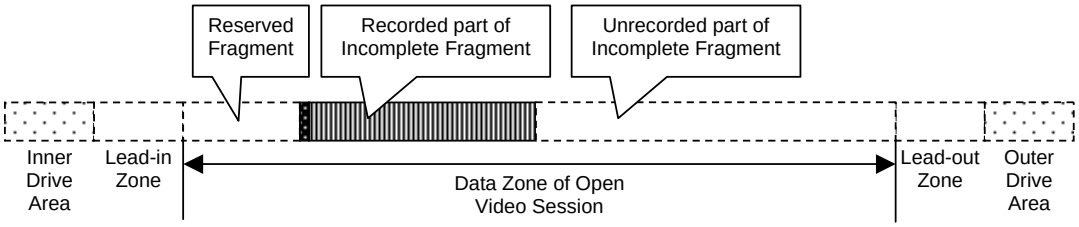

Figure 1: Example of disc with open DVD+R Video Session

2. The DVD+R Video Session is closed, the disc is not finalised
   In this case the first Session is closed. Additional Sessions may be recorded, but only the first Session is a DVD+R Video Session. If there is more than one Session, all Sessions except possibly the last Session are closed, but the disc is not finalised.

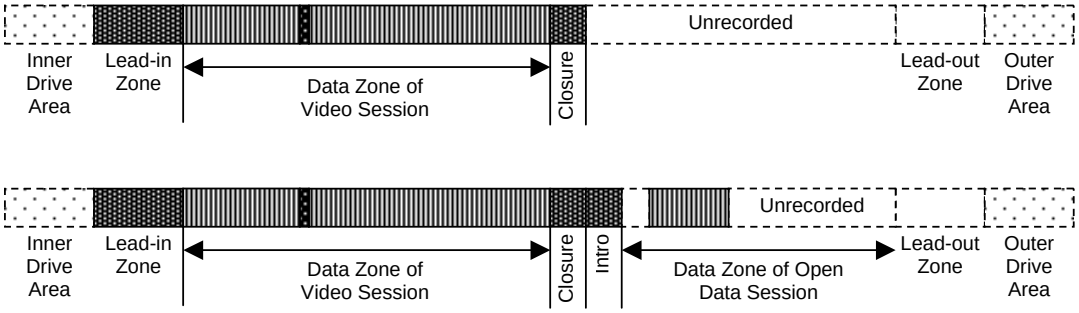

Figure 2: Examples of unfinalised discs with closed DVD+R Video Session

Note: Compatibility of dual layer discs in this state with read-only play back devices is expected to be low.

3. The DVD+R Video disc is finalised
   In this case all Sessions are closed and the disc is finalised. One or more Sessions are recorded, but only the first Session is a DVD+R Video Session.

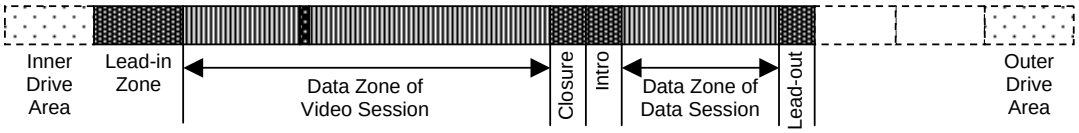

Figure 3: Example of finalised disc

Details about Reserved Fragments, open Sessions, closed Sessions and finalised discs can be found in [1] and [2].

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2.2 Copy Management

2.2.1 General

The video-recording format specified in this document shall not be applied for recording of video content that is indicated as “Copy Never” or as “Copy No More”.

2.2.2 RSV field in the Data Frames

Refer to section 13.1.3 of [1]. All bytes of the RSV field in the Data Frames except for the first RSV byte in Data Frames that are part of the Data Zone are reserved and shall be set to (00b).

First RSV byte in Data Frames that are part of the Data Zone:

b7	b6	b5	b4	b3	b2	b1	b0
CPM	reserved	CGMS		APT		reserved	

CPM … Copyrighted Material
- 0b : This Data Frame does not contain copyrighted material
- 1b : This Data Frame contains copyrighted material

CGMS … Copy Generation Management System
If CPM is set to (0b), this field is reserved.
If CPM is set to (1b), the value stored in this field has the following meaning:
- 00b : The contents of the Data Frame may be copied without restriction.
- 01b : Reserved
- 10b : Reserved
- 11b : The content of the Data Frame is a copy of which no more copies are allowed (“Copy No More”).

APT … Application Type
- 00b : This Data Frame does not contain data belonging to files included in the VIDEO_RM or the VIDEO_TS directory.
- 01b : This Data Frame contains or may contain data belonging to files included in the VIDEO_RM or the VIDEO_TS directory.
- 10b : Reserved
- 11b : Reserved

Note: This specification allows that APT for all sectors in the Data Zone of a DVD+RW Video disc be set to 01b.

Note: Recorders and recording drives shall be considered as circumvention devices when these are produced to record, or can be modified to record, in any manner, a user-defined number in the RSV field.

2.2.3 Content Provider Information

Refer to section 18.8.3 of [1] and [7]. All bytes of the Content Provider Information field shall be set to (00h).

Note: Recorders and recording drives shall be considered as circumvention devices when these are produced to record, or can be modified to record, in any manner, a user-defined number in this field.

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2.2.4 Copy Generation Management System

CGMS fields in the File System may be set to (00b) for files with CGMS fields set to (00b) in all Data Frames with data belonging to the file. CGMS fields in the File System shall be set to (11b) for files with the CGMS field set to (11b) in at least one of the Data Frames with data belonging to the file. CGMS fields in the File System shall never be set to (01b) or (10b).

Note: In some cases a video recording application cannot always be sure that for a certain file, all CGMS fields in the Data Frame headers are set to (00b). In that case the CGMS field for the file shall be set to (11b).

In addition to the CGMS fields in the File System and in the RSV fields of the Data Frames, recorders shall set the Real-Time CGMS fields in the Real-Time Attributes. See [3] Royal Philips Electronics: *DVD+RW Video Format Specifications (Version 3.0, July 2005)*for details.

2.2.5 Analog Protection System trigger bits

APS trigger bits (APSTB) in the DVD-Video Zone shall be set to (00b).

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2.3 DVD+R Video Session layout

2.3.1 Layout of a closed DVD+R Video Session

The application data layout of the Data Zone of a closed DVD+R Video Session is similar to the Data Zone layout of a DVD+RW Video disc according to a format specified in [3] (with optional exceptions described in section 2.5). The version number recorded in the VERN field in VRMI shall indicate with which of the specifications the format complies (video version 1,2 or 3). The layout is illustrated in Figure 4.

All sectors in the area starting at LSN (000000h) up to and including the UDF Second Anchor Volume Descriptor Pointer (2nd AVDP) shall be recorded. In case of a finalised single Session disc, the 2nd AVDP is followed by a Lead-Out otherwise it is followed by a Closure.
A disc with a closed DVD+R Video Session can be created either by closing an open DVD+R Video

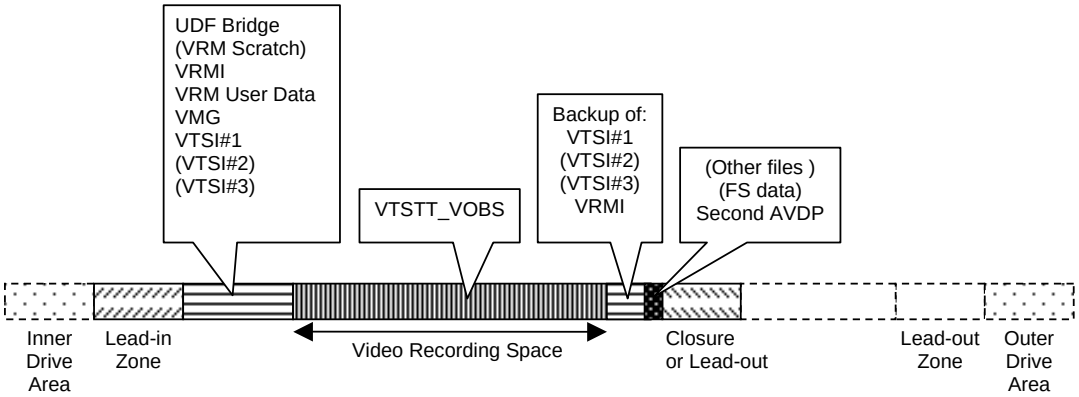

Figure 4: Layout of a closed DVD+R Video Session

Session or by writing all data “at once”.

2.3.2 Layout of an open DVD+R Video Session

2.3.2.1 General layout

The Data Zone of an open DVD+R Video Session contains exactly two Fragments: one Reserved Fragment, followed by one Incomplete Fragment. At least an area of 3MB in front of the highest possible logical address of the start of the Lead-Out Zone shall be left unrecorded.

The start address of the Reserved Fragment is PSN (030000h) and the end address is PSN (033DFFh). The Reserved Fragment shall be kept completely blank (unwritten) until the Session is closed. Data intended for this area of 31 MB is temporarily written into the Incomplete Fragment.

Note: A Run-in block of 16 sectors is recorded in between the Reserved Fragment and the Incomplete Fragment at the moment the Reserved Fragment is created. See [1] for details.

The start address of the Incomplete Fragment is PSN (033E10h). The Incomplete Fragment shall start with a buffer area of 496 sectors containing arbitrary user data (not belonging to a file). The Incomplete Fragment shall end with the RSAT area, which contains the Reserved Space Allocation Table as defined in chapter 3. See the illustration in Figure 5.

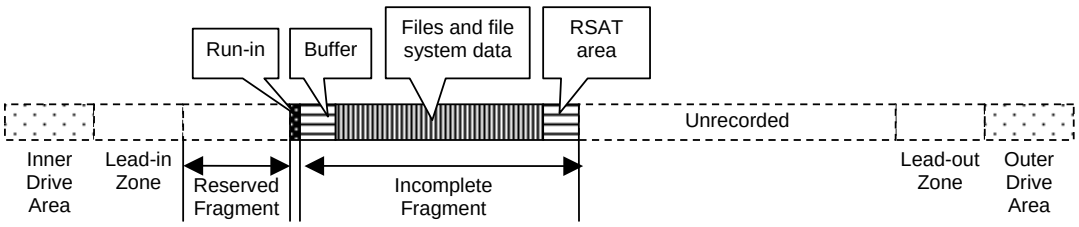

Figure 5: Layout of an open DVD+R Video Session

If on a dual layer disc the layer jump position is fixed in the Table of Contents Blocks, the Incomplete Fragment shall be written up to or beyond the layer jump position.

Note: The DVD+R-DL specification [2] allows the layer jump location to be set to a value different from the default (highest possible) value. Video recorders may use this feature, but they have to guarantee that when the disc leaves the tray, either the jump position can still be set to a value different from the default or layer 0 is completely written. This restriction makes it easier for recorders to create near-seamless layer jumps.

The Incomplete Fragment shall contain all files and file system data that is required to be present in the Data Zone of a closed DVD+R Video Session with a data format according to [3]. The version number recorded in the VERN field in VRMI shall indicate with which of the two specifications the format complies (video version 1, 2 or 3). The recording of files that are not included in the VIDEO_TS or the VIDEO_RM directory (“other files”) is prohibited. For an open DVD+R Video Session the data allocation rules of clause 2.3.2.2 shall be applied.

For the case that the version number recorded in the VERM field in the VRMS is (0020h) then only the additional number of commands in the PGC Command Table may be used. In particular the start position for the video recording will be LSN 0040000h and there will be no data section.

For the case that the version number recorded in the VERN field in VRMS is (0030h) then the additional features in DVD+RW Video version 3 (refer to Reference [3]) for VCPS are allowed as well as the additional number of commands in the PGC Command Table.

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2.3.2.2 Data allocation rules

The following allocation rules apply for video and file system data in an open DVD+R Video Session:

1. Data that does not required to be moved to the Reserved Fragment when the DVD+R Video Session is closed will follow the allocation rules for DVD+RW Video (refer to Reference [3]). This rule applies for the VTSTT_VOBS, the VTSI backup files, the VRMI backup file, other files and file system data (if present) and the 2nd AVDP.

2. Data that is to be recorded in the Reserved Fragment when the DVD+R Video Session is closed, is temporarily allocated somewhere in the Incomplete Fragment. The mapping rules for this data, defined in 2.3.2.3, shall be applied. This data will become obsolete after the Session is closed. Data structures affected by this rule include UDF Bridge file system data, VRM Scratch (if present), VRMI, VRMI User Data, VMG and the VTSI files. The intended locations for these data structures in the closed Session are mapped to actual locations in the Incomplete Fragment. Intended locations shall be in the address space from PSN (030000h) up to but not including PSN (033E00h).

2.3.2.3 Mapping rules

Mapping is done according to the following rules:

1. Mapping is applied on an ECC Block basis. Within an ECC Block, data is recorded at the actual location in the same order as it would have been at the intended location.

2. VRMI, VMGI, VMGI backup, and the VTSI structures shall each be allocated contiguously in the Incomplete Fragment.

3. Within the VIDEO_TS.VOB file, data within a Cell or within a sequence of seamlessly connected Cells shall be allocated contiguously.

4. The mapping of ECC Block locations in the Reserved Fragment to ECC Block locations in the Incomplete Fragment is recorded in a Reserved Space Allocation Table (RSAT). When the ECC Block location mapping is applied when reading the data, the reading device shall see a compliant DVD+RW Video Data Zone (with the exceptions described in section 2.5).

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2.3.2.4 RSAT area

The RSAT area consists of the last 2 or 3 recorded ECC Blocks of the Incomplete Fragment, each containing an instance of a Reserved Space Allocation Table (RSAT), as depicted in Figure 6. The instances are identical and are located starting from the first byte of the first sector of each ECC Block.

On a DVD+R Video disc the size of the RSAT is 6144 bytes (3 sectors). After the RSAT starting at the lowest LSN, all bytes not belonging to one of the RSAT instances shall be reserved (set to 00h).

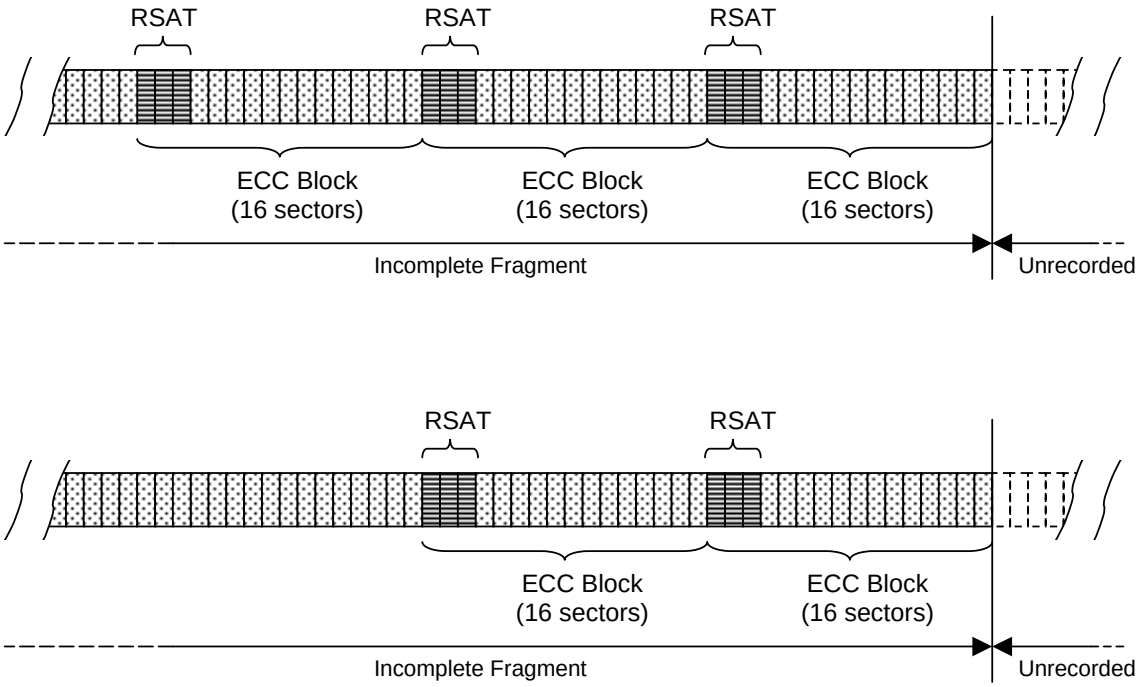

Figure 6: RSAT area with 3 respectively 2 ECC Blocks

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2.4 File System

2.4.1 File System of closed DVD+R Video Session

The File System structures of a closed DVD+R Video Session fully comply with the specifications for the File System structures on a DVD+RW Video disc, with the exception that the VRM Scratch file (VIDEO_RM.DAT) is optional instead of mandatory.

2.4.2 File System of open DVD+R Video Session

The File System structures of an open DVD+R Video Session fully comply with the specifications for the File System structures of a closed DVD+R Video Session, taking into account the sector mapping as described in the Reserved Space Allocation Table. Only files recorded in the VIDEO_TS directory or in the VIDEO_RM directory are allowed.

Note: In the closed DVD+R Video Session it is allowed to record additional data files outside the VIDEO_TS and VIDEO_RM directory. These files could be added just before the Session is closed or they could be included when the Session is recorded in one run (Session at once). There are two different ways to include data files in the Video Session depending on the version number of the DVD+RW Video specification: according to the version 1 format or according to the version 2 and 3 formats as described in [3]. Alternatively, additional data files could be added in a second (or further) Session.

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2.5 Video Application

2.5.1 General

Except for the VOB data in the VTSTT_VOBS, DVD+R Video data structures can be updated by writing new versions to the Incomplete Fragment. Therefore, all DVD+RW Video application features that do not require changes to the VTSTT_VOBS are available on a DVD+R Video disc. Examples of such features are the creation of a VR Play List and deleting Titles. The following clauses specify the differences with the DVD+RW Video Format at the application level.

To avoid compatibility issues if the data is copied from a closed DVD+R Video Session to a DVD+RW disc e.g. for editing, it is recommended to ensure full compatibility with the DVD+RW Video specifications when the Video Session is closed.

2.5.2 VRM Scratch

VRM Scratch may be omitted from an open DVD+R Video Session. It may also be omitted from a closed session, but this is not recommended.

Note: In the DVD+RW Video Format the VRM Scratch area is mandatory. DVD+RW recorders may use this area to temporarily store data, even if the recording device is not the owner of the menu. On a DVD+R or DVD+R-DL disc, this type of usage doesn't make sense for a closed Session.

2.5.3 Deleted Recordings and recording space at end of Data Zone

For an open DVD+R Video Session, the following rules apply:

- If the last Recording is a Deleted Recording, this Recording shall be represented in the TT_SRPT by Free Space Titles (one Full Title and one Play List Title).

- The recording space after the last RSAT area shall be represented in the TT_SRPT by Free Space Titles (one Full Title and one Play List Title) if there is at least 80 MB recording space left before the last possible Lead-out Zone position. If there is between 10 and 80 MB recording space left, these Free Space Titles may be omitted. If there is less than 10 MB recording space left, there shall be no Free Space Titles included in the TT_SRPT to represent this space.

Note: In case the last Recording before the remaining recording space is a Deleted Recording, one Full Title (and one Play List Title) for the Deleted Recording and one Full Title (and one Play List Title) for the remaining recording space at the end are included in the TT_SRPT.

When the DVD+R Video Session is closed, Free Space Titles added to the TT_SRPT to represent free space at the end of the Data Zone (but not associated with a Recording) may be omitted.

Note: DVD+RW Video requires that, as long as the disc is not full, Free Space Titles are included to the TT_SRPT to represent the available recording space at the end. When the first Session on a DVD+R Video disc is closed, there is no available recording space left. However, to enable closing the open Session by simply copying data, the TT_SRPT may be kept identical to the last one used in the open session.

2.5.4 Video Title Set Information (VTSI)

On a DVD+R disc the maximum size of the VTS_VOBU_ADMAP is 80 sectors and the maximum size of the VTSI is 141 sectors, which is the same as for DVD+RW discs. On a DVD+R-DL disc the maximum allowable sizes for the VTS_VOBU_ADMAP and the VTSI are increased to 160 and 221 sectors respectively.

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Recommendation: It is recommended not to exceed the original maximum size of 80 sectors for the VTS_VOBU_ADMAP and 141 sectors for the VTSI on DVD+R-DL discs as long as the size of the Video Session is below 143444 ECC blocks (number of blocks on single layer 12 cm disc).

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3. Reserved Space Allocation Table

3.1 Introduction

The Reserved Space Allocation Table (RSAT) provides the mechanism to treat the Reserved Fragment of the open DVD+R Video Session as a virtual rewritable area of 31 MB.

As long as the Session is open, writing to locations below LSN (003E00h) results in appending to the Incomplete Fragment followed by writing an updated version of the RSAT. Reading from locations below LSN (003E00h) results in reading from locations in the Incomplete Fragment, according to the mapping information provided by the RSAT.

When finalising the disc the RSAT could be used to find the location of data that needs to be copied to the Reserved Fragment.

When the disc contains the structures for the Video Content Protection System (Reference [8]), then the first ECC block of the reserved fragment (from LSN (000000h) is reserved and thus cannot mapped by information in the RSAT. The first ECC block is written when the Buffer Zone 2 is written and must not be overwritten when finalising the disc. The RSAT has a separate format for discs with VCPS information in the Buffer Zone 2 (Reference [8]).

Note: Some implementations might also want to update the DVD menu and other data structures when finalising the disc.

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3.2 Format of RSAT for disc with no VCPS

RBP		Contents	Number of bytes
0	RSAT_ID	RSAT Identifier	4 bytes
4	reserved	reserved	2 bytes
6	RSAT_COUNT	RSAT update counter	2 bytes
8	RSAT_FMT_ID	RSAT Format Identifier	1 byte
9	PREV_RSAT	Previous location of RSAT	3 bytes
12	reserved	reserved	1 byte
13	END_DATA	End of active part of Data Zone	3 bytes
16	RSAT_MAPT_SA	Offset to start of RSAT_MAPT	2 bytes
18	RSAT_MAPT_SZ	Size of RSAT_MAPT	2 bytes
20	reserved	reserved	1004 bytes
1024	RSAT_UD	RSAT user data	1024 bytes
2048	RSAT_MAPT	RSAT Mapping Table containing 992 RSAT_ITEMs of 4 bytes	3968 bytes
6016	reserved	reserved	128 bytes
		Total	6144 bytes

(RBP 0) RSAT_ID
RSAT Identifier containing the string “RSAT” with a-characters of the ISO-646 character set.

(RBP 6) RSAT_COUNT
RSAT_COUNT contains a value indicating the version number of RSAT. The first time an RSAT is recorded on the disc this field is set to 0. For each new version of RSAT the value of this field is incremented by one. If necessary, RSAT_COUNT wraps around from 65535 to 0.

Note: All instances of the RSAT in the RSAT area have the same value of RSAT_COUNT.

(RBP 8) RSAT_FMT_ID
This field contains the fixed value (01h) indicating RSAT format mode 1 as used by the DVD+R Video application with no VCPS.

(RBP 9) PREV_RSAT
This field contains the LSN of the location of the first instance of the previous version of RSAT. For the first version of RSAT the value of PREV_RSAT shall be (000000h).

(RBP 13) END_DATA
This field contains the LSN of the last sector containing application data that is not intended to be allocated in the Reserved Fragment. END_DATA indicates the location of the 2nd AVDP of UDF.

(RBP 16) RSAT_MAPT_SA
This field contains the fixed value (0800h) indicating the start address of RSAT_MAPT in bytes relative to the start address of RSAT.

(RBP 18) RSAT_MAPT_SZ
For RSAT format mode 1, this field contains the fixed value (0F80h) indicating the size of RSAT_MAPT in bytes.

(RBP 1024) RSAT_UD
The recorder that recorded the RSAT may use this field to store additional information.

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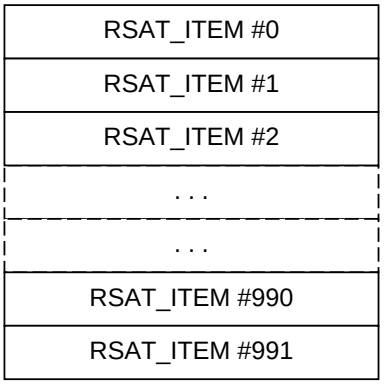
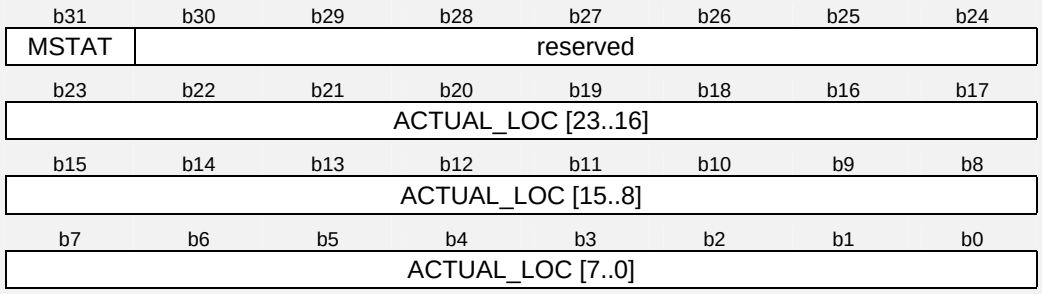
3.2.1 Format of RSAT_MAPT for disc with no VCPS

RSAT_MAPT contains a list of 992 RSAT_ITEM fields, implicitly numbered from 0 to 991 depending on the position in the list.



RSAT_ITEM #n contains the mapping information for the (n+1)st ECC Block in the Reserved Fragment.

RSAT_ITEM #n



MSTAT
This field indicates the mapping status for the (n+1)st ECC Block in the Reserved Fragment.

0b : This ECC Block is not in use.
1b : This ECC Block is mapped to another location.

If MSTAT equals (0b), no data is recorded for logical sectors in the range from LSN = (n x 16) to LSN = ((n x 16) + 15).

If MSTAT equals (1b), data recorded for logical sectors in the range from LSN = (n x 16) to LSN = ((nx16)+15) can be found at locations indicated by ACTUAL_LOC.

ACTUAL_LOC
If MSTAT equals (1b), this 24-bit field contains the LSN of the first sector of the ECC Block where the data is actually recorded. The value recorded in ACTUAL_LOC shall be a multiple of 16.

Note: The three least significant bits of ACTUAL_LOC shall always be set to (000b).

If MSTAT equals (0b), the value recorded in ACTUAL_LOC shall be (000000h).

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3.3 Format of RSAT for disc with VCPS structures

RBP		Contents	Number of bytes
0	RSAT_ID	RSAT Identifier	4 bytes
4	reserved	reserved	2 bytes
6	RSAT_COUNT	RSAT update counter	2 bytes
8	RSAT_FMT_ID	RSAT Format Identifier	1 byte
9	PREV_RSAT	Previous location of RSAT	3 bytes
12	reserved	reserved	1 byte
13	END_DATA	End of active part of Data Zone	3 bytes
16	RSAT_MAPT_SA	Offset to start of RSAT_MAPT	2 bytes
18	RSAT_MAPT_SZ	Size of RSAT_MAPT	2 bytes
20	reserved	reserved	1004 bytes
1024	RSAT_UD	RSAT user data	1024 bytes
2048	RSAT_MAPT	RSAT Mapping Table containing 992 RSAT_ITEMs of 4 bytes	4096 bytes
		Total	6144 bytes

(RBP 0) RSAT_ID
RSAT Identifier containing the string “RSAT” with a-characters of the ISO-646 character set.

(RBP 6) RSAT_COUNT
RSAT_COUNT contains a value indicating the version number of RSAT. The first time an RSAT is recorded on the disc this field is set to 0. For each new version of RSAT the value of this field is incremented by one. If necessary, RSAT_COUNT wraps around from 65535 to 0.

Note: All instances of the RSAT in the RSAT area have the same value of RSAT_COUNT.

(RBP 8) RSAT_FMT_ID
This field contains the fixed value (02h) indicating RSAT format mode 2 as used by the DVD+R Video application with VCPS.

(RBP 9) PREV_RSAT
This field contains the LSN of the location of the first instance of the previous version of RSAT. For the first version of RSAT the value of PREV_RSAT shall be (000000h).

(RBP 13) END_DATA
This field contains the LSN of the last sector containing application data that is not intended to be allocated in the Reserved Fragment. END_DATA indicates the location of the 2nd AVDP of UDF.

(RBP 16) RSAT_MAPT_SA
This field contains the fixed value (0800h) indicating the start address of RSAT_MAPT in bytes relative to the start address of RSAT.

(RBP 18) RSAT_MAPT_SZ
For RSAT format mode 2, this field contains the fixed value (1000h) indicating the size of RSAT_MAPT in bytes.

(RBP 1024) RSAT_UD
The recorder that recorded the RSAT may use this field to store additional information.

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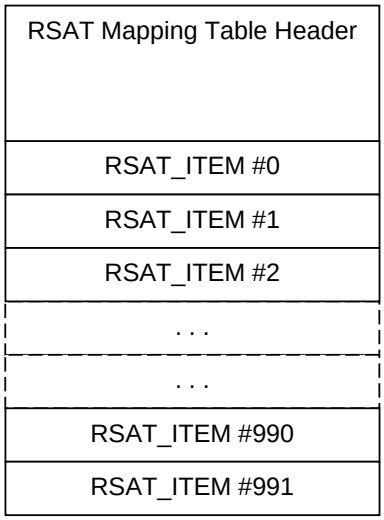
3.3.1 Format of RSAT_MAPT for disc with VCPS structures

RSAT_MAPT contains a 128 byte header and a list of 992 RSAT_ITEM fields, implicitly numbered from 0 to 991 depending on the position in the list.



RSAT Mapping Table Header is 128 bytes and contains zeros

RSAT_ITEM #n contains the mapping information for the (n+1)st ECC Block in the Reserved Fragment.

RSAT_ITEM #n

b31	b30	b29	b28	b27	b26	b25	b24
MSTAT	reserved						
b23	b22	b21	b20	b19	b18	b16	b17
ACTUAL_LOC [23..16]							
b15	b14	b13	b12	b11	b10	b9	b8
ACTUAL_LOC [15..8]							
b7	b6	b5	b4	b3	b2	b1	b0
ACTUAL_LOC [7..0]							

MSTAT
This field indicates the mapping status for the (n+1)st ECC Block in the Reserved Fragment.

0b : This ECC Block is not in use.
1b : This ECC Block is mapped to another location.

If MSTAT equals (0b), no data is recorded for logical sectors in the range from LSN = (n x 16) to LSN = ((n x 16) + 15).

If MSTAT equals (1b), data recorded for logical sectors in the range from LSN = (n x 16) to LSN = ((nx16)+15) can be found at locations indicated by ACTUAL_LOC.

ACTUAL_LOC
If MSTAT equals (1b), this 24-bit field contains the LSN of the first sector of the ECC Block where the data is actually recorded. The value recorded in ACTUAL_LOC shall be a multiple of 16.

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Note: The three least significant bits of ACTUAL_LOC shall always be set to (000b).

If MSTAT equals (0b), the value recorded in ACTUAL_LOC shall be (000000h).

The first ECC block is not used and thus MSTAT equals (0b) for RSAT_ITEM #0

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A. Video recording example (informative)

A.1 Introduction

This Annex shows an example of using a DVD+R disc for making video recordings. In the example it is assumed that two recordings are made with the same picture size. Consequently there is just one VTSI and one VTSI backup (“bup”).

A.2 First recording

The following steps are involved in making a first recording on a blank DVD+R disc:

1. The drive is requested to create a Reserved Fragment starting at PSN (030000h) up to PSN (033E00h). This includes writing a Session DCB in the Inner Disc Identification Zone and writing a Run-in Block of 16 sectors with arbitrary data starting at PSN (033E00h). Reserved Zone 2 in the lead in shall be filled with zeros. See [1] for details related to this first step. Alternatively this step could be done after step 5.
2. Arbitrary data is written to the buffer area starting at PSN (003E10h) and ending just before PSN (034000h).
3. An MPEG-2 Program Stream with the audio-visual content for the first recording is written starting from PSN (034000h). Recording stops at a 16-sector boundary; if necessary the stream is padded with arbitrary data. The recorded stream complies with the VTSTT_VOBS specifications defined in the DVD+RW Video Format Specifications [3].
4. All additional files and file system data as required by the DVD+RW Video Format Specifications are appended from the last written address. The backup file for VTSI, the backup file for the VRMI and the Second AVDP are recorded in this order.
5. An RSAT area of 32 (or 48) sectors is appended from the last written address, including 2 (or 3) instances of RSAT with RSAT_COUNT set to 0.

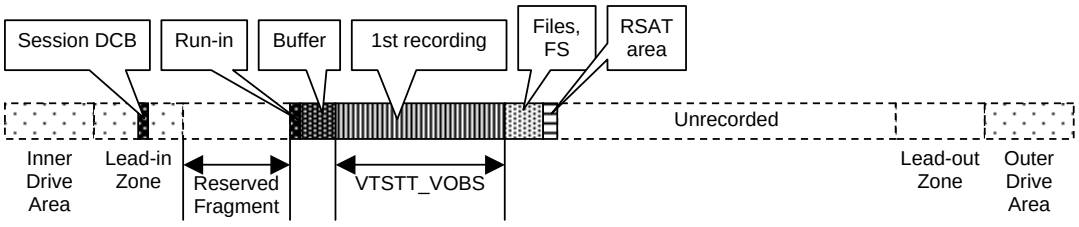

Figure 7: Disc layout after first recording

A.3 Second recording

The following steps are involved in making a second recording on a DVD+R disc:

6. An MPEG-2 Program Stream with the audio-visual content for the second recording is written starting from the next writable address after the previous step. Recording stops at a 16-sector boundary. The area starting at PSN (034000h) until the end of the second recording complies with the VTSTT_VOBS specifications as defined in the DVD+RW Video Specifications [3]. Note that the previously written additional files, file system data and the old RSAT area are fully absorbed by the new VTSTT_VOBS.
7. All updated files and file system data are recorded following the new VTSTT_VOBS. This step is basically identical to step 4. If a multi-page menu is created with each page implemented as a non-seamlessly connected Cell exactly fitting into an integer number of ECC blocks, unchanged

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pages need not be rewritten. Actual addresses in the ACTUAL_LOC fields in RSAT may be pointing to sectors of menu pages that are temporarily located in the VTSTT_VOBS.

8. A new RSAT area with RSAT_COUNT set to 1 is added.

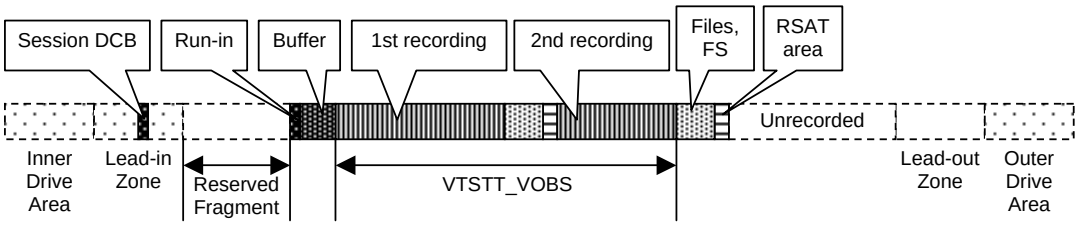

Figure 8: Disc layout after second recording

A.4 Partially updating the Temporary Overview Space

In some cases the contents of the Video Recording Manager (VRM) and perhaps the Video Manager (VMG) changes without the necessity to make changes to the VTSTT_VOBS. In the case that a user creates a VR Play List, only the contents of VRMI (VIDEO_RM.IFO) and the backup of VRMI (VIDEO_RM.BUP) changes. When he changes the name of a recording, also the file containing the menu content (VIDEO_TS.VOB) may need to be updated and perhaps the VMGI file (and backup copy).

The following steps are involved:

9. Write the new version of VRMI, the backup of VRMI, necessary VMG files.
10. Write a new Second AVDP. At least it is required that the Second AVDP is recorded after the backup of VRMI. Both are not mapped by the RSAT.
11. If necessary, rewrite part of the file system data. This may be necessary when menu pages are added.
12. Add 32 (or 48) additional sectors with RSAT_COUNT set to 2.

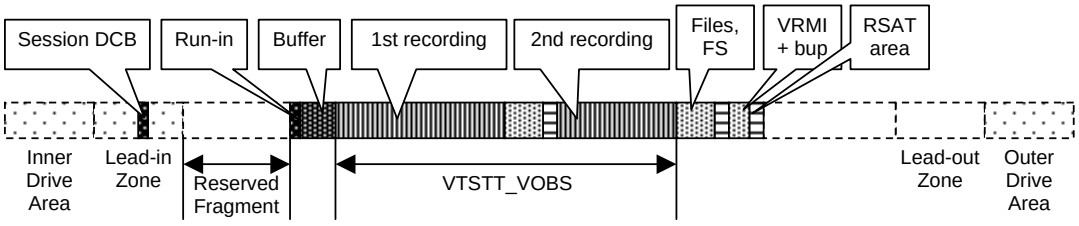

Figure 9: Disc layout after updating the Temporary Overview Space

A.5 Close the DVD+R Video Session

If the user requests to close the DVD+R Video Session, the following could be followed:

13. Copy data to the Reserved Fragment according to the mapping information in RSAT.
14. Write arbitrary data to all sectors in the Reserved Fragment that are still unrecorded after the previous step.
15. Add the final Second AVDP at the end of the Data Zone.
16. Write the unrecorded parts of the Lead-in Zone including the Control Data Zone.
17. Write a Closure to close the Session. No more DVD+R Video content can be added to the disc after this, but if there is enough space left, it is possible to add other data.

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Alternatively the disc could be finalised by writing a Lead-out instead of a Closure. In that case no more data can be added to the disc at all.

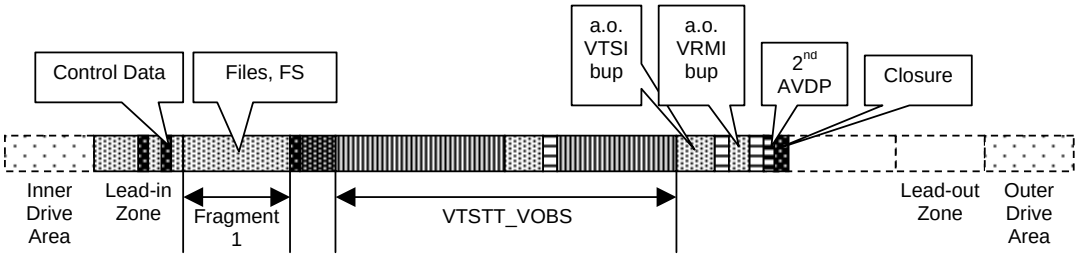

Figure 10: Disc layout after closing the disc

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B. Guidelines for dual layer discs

Refer to section 1.5 of [3] for the definitions of some of the terminology used in this Annex.

B.1 Layer jump

According to the DVD+R-DL specification [7], the layer jump location in the Data Zone is at an ECC block boundary. According to the DVD-Video specification [5], a Cell shall not be allocated such that part of it is recorded on one layer, while another part is recorded on the other layer. In addition to this, a seamless connection between two Cells on different layers is not allowed, even if they are logically adjacent.

An example of logically adjacent Cells at the layer jump position is depicted in Figure 11.

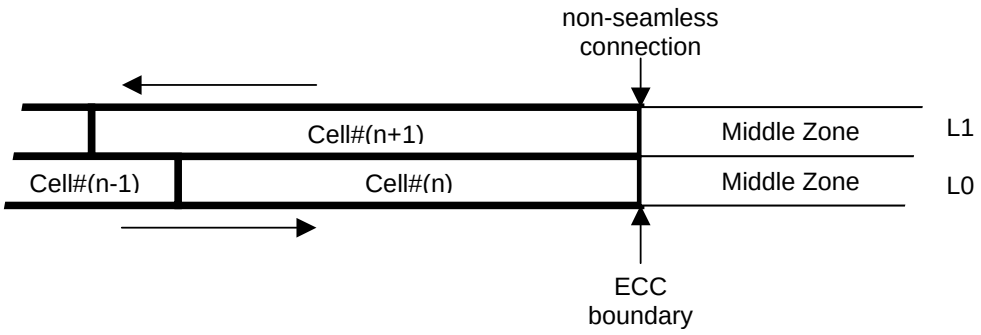

Figure 11: Layer jump with logically adjacent Cells

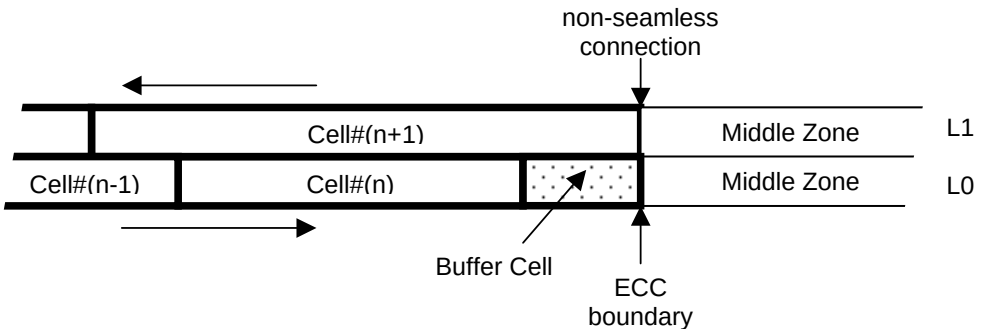

Figure 12: Layer jump with Buffer Cell

It is the responsibility of the application to align the Cell boundary with the ECC block boundary. To avoid this complication, a Buffer Cell might be used for stuffing, as depicted in Figure 12.

Neither of the two configurations guarantee seamless playback across the layer jump. According to the DVD+RW Video specifications, logically adjacent Cells belong to the same VOB, which implies that the MPEG Program Stream is continuous across the layer jump. As a result of that some playback devices might give a better performance when there is no Buffer Cell in between the two Cells.

Note: To improve seamless playback performance, recording devices might lower the bitrate of the recorded stream during the last seconds before the layer jump.

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B.2 Cell ID budget

Refer to Annex D (Restrictions) of the DVD+RW Video Specifications, Reference [3].

For single or dual layer DVD+R discs all restrictions of D.1 are applicable without change.

The recommendations for maintaining a Cell ID budget given in D.2, have been written with DVD+RW discs in mind. They can equally well be applied for DVD+R discs, although in that case there is no worry about consuming too many Cell ID numbers by editing. On DVD+R discs, editing is only possible by creating and modifying VR Play Lists, or by modifying DVD Play Lists on Cell basis: the Cell partitioning is fixed once the stream is recorded.

If the recommendation of Note 1 of Annex D.3 is followed, there is no Cell ID budget issue on DVD+R discs: it is recommended that when new recordings are made, recorders create Cells that are at or close to the maximum allowed playback time at the selected bitrate.

When following the recommendation on the Cell playback time, on average only 123 Cell IDs are used on a single layer and 224 Cell IDs on a dual layer disc. Smaller Cells are sometimes necessary, e.g. at the end of a recording or when additional DVD compatible chapter boundaries are created during recording. It is left to the implementation to deal with potential Cell ID budget conflicts in a proper way for the user.

B.3 Additional considerations

B.3.1 Long recording times

DVD+R-DL discs enable recording of many hours of video, e.g. with an average bitrate of 1.2 Mbps almost 16 hours of video could be recorded. As the DVD+RW Video format was originally designed with single layer discs in mind, care must be taken that all rules of the format are obeyed when recording with low bitrates on a dual layer disc. Allowing additional space for the VTS_VOBU_ADMAP in the VTSI on dual layer discs (see 2.5.4) solves one issue. Another issue comes up when recording many hours in one take. The maximum recording time of one VOB is 2^{20} frames, due to the fixed offset between VOB_V_S_PTM and VOB_V_E_PTM (see section 3.3.7.2 of [3]). As seamless connections between VOBs are not supported, other solutions must be applied. This is left to the implementation.

B.3.2 Quality levels

In Annex B.4 of the DVD+RW Video specification ([3]) recommended quality levels are defined. When applying the same bitrate levels as indicated in the table in B.4 to a dual layer disc, the recording time should be multiplied with a factor of about 1.82. However, users might expect double recording times for dual layer discs. To meet the user's expectations, recording devices could for instance apply other bitrate levels for the same quality level presented to the user. For High Quality it is recommended that bitrate level 4 is still used to give the highest quality, and for Super Extended Play it is not possible to select a bitrate level higher than 34. For the other qualities it is recommended that the recorder use a higher bitrate level than with single layer to provide double recording times. The recommended levels are given in the table below.

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Table 3-1 Recommended Recording Levels for Dual Layer Discs

Quality Level		Bitrate level	Bitrate (Mbps)	Recording time (h:mm:ss)
Mnemonic	**Name**			
HQ	**High Quality**	4	9.716	1:56:47
SP	**Standard Play**	9	4.509	4:11:37
LP	**Long Play**	13	3.122	6:03:28
EP	**Extended Play**	18	2.255	8:23:15
SLP	**Super Long Play**	26	1.561	12:06:56
SEP	**Super Extended Play**	34	1.194	15:50:36

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List of Changes

Differences between System Description DVD+R:
Video Format Specifications, Version 2.1, June 2004
and this Video Format Specifications, Version 3.0, July 2005

Main change:

- An additional RSAT format has been introduced for VCPS discs and the version number recorded in the VERN field in VRMI may have the value 30 to allow recordings with VCPS encryption.

Section	Location	Version 2.1	Version 3.0	Comment
1.4	At [1]	*"(Version 1.2, July 2003)"*	*"(Version 1.3, July 2004)"*	Version 1.3 replaces 1.2
1.4	At [3]	"(Version 2.1, June 2004)"	"(Version 3.0, July 2005)"	Version 3.0 replaces versions 2.1
1.4	[8]	-	"Philips, Video Content Protection System …, System Description (Version 1.3)"	Support added for VCPS
2.2.4	At end	"(Version 2.1, June 2004)"	"(Version 3.0, July 2005)"	References updated.
2.3.2.1	At end	"VERN field of VRMI_GI set to (0010h)"	"VERN field in VRMI shall indicate with which of the specifications the format complies…"	DVD+RW Video Recording format v2 and v3 allowed
2.4.2	At end	version 1 format as described in [3] or according to the version 2 format as described in [8].	"version 1 format or according to the version 2 and 3 formats as described in [3]. "	Removed incorrect reference.
2.5.4		Max VTSI size 112 and 191 for DL DVD+R-DL	Max VTSI size 141 and 221 for DVD+R-DL	Updated to conform to DVD+RW video version 3.0
3.1	At end	-	"When the disc contains the structures for the Video Content Protection System …"	Additions for new RSAT format
3.2	Whole section	"Format of RSAT …"	"Format of RSAT for disc with no VCPS…"	Additional RSAT format for discs with VCPS
3.3	Whole section	-	"Format of RSAT for disc with VCPS structures…"	Additional RSAT format for discs with VCPS
A.1	Section 1	"Reserved Zone 2 and Buffer zone 2 in the Inner Disc Identification Zone shall be filled with zeros"	"Reserved Zone 2 in the lead in shall be filled with zeros"	Reflecting new version of [1]
B.3.2	At end	-	New table of recommended recording levels	

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